## CLAIMS

We claim:

5   1. A computer system comprising one or more memories, one or more

central processing units and further comprising:

.

one or more input devices for receiving one or more input meshes

representing a three dimensional model, the three dimensional model

10   capable of being represented as a 2-manifold polygon mesh; and

a conversion process that automatically converts the input mesh to a

multiresolution quadrilateral-based subdivision surface (MQSS)

representation.

15

2. A computer system comprising one or more memories, one or more

central processing units and further comprising:

one or more input devices for receiving one or more input meshes

representing a three dimensional model, being a 2-manifold polygon mesh,

each of the input meshes having one or more features, each of the features

being a part of the model with a different curvature and scale than one or

5    more adjacent parts; and


a conversion process that automatically converts the input mesh to a

multiresolution quadrilateral-based subdivision surface (MQSS)

representation.

10


3. A system, as in claim 1, where the system further comprises one or more

of the flowing: an output for displaying the MQSS, a process for storing the

MQSS in one or more of the memories.

15


4. A computer system comprising one or more memories, one or more

central processing units and further comprising:

one or more input devices for receiving one or more input meshes

representing a three dimensional model, each input mesh being a 2-manifold

polygon mesh, each of the input meshes having one or more features, a

feature being a perceptually important part of the model with a different

5    curvature than one or more adjacent parts; and


a conversion process that automatically converts the input mesh into a

multiresolution quadrilateral-based subdivision surface (MQSS) having a

base mesh with one or more base mesh edges where one or more of the base

10   mesh edges correspond to one of the features.


5.  A computer system, as in claim 4, where the MQSS is used for one or

more of the following: model editing, compression of the input mesh,

a network transmission, model storage, a level of detail representation,

15       an input model parameterization.


6.  A computer system, as in claim 4, where the base mesh is one or more

of the following: a parameterization domain for the input model, a

coarse approximation of the input model, a texture mapping domain.

20

7. A computer system, as in claim 4, where the feature is one or more of the following: a perceptually salient ridge on the input model, a perceptually salient ravine on the input model, a perceptually salient crease, a perceptually salient curve, or some other perceptually salient

5     element.

8. A computer system, as in claim 4, where the conversion process comprises the steps of:

10     a. generating an atlas decomposition of the input mesh by using an atlas generation process;

    b. extracting a quadrilateral base mesh using a quadrilateral mesh

15     extraction process, the atlas, and the input mesh; and

    c. extracting the MQSS with one or more levels from the input mesh and the quadrilateral base mesh.

9. A computer system, as in claim 4, where the atlas generation process comprises the steps of:

5

    a.  selecting a seed set of one or more chart seeds;

    b.  computing a constrained centroidal Voronoi decomposition of the input mesh around the chart seeds, the constrained

10          centroidal Voronoi decomposition having one or more cells;

    c.  splitting the cells that do not satisfy a height field approximation criterion into height fields resulting in a partition of the input mesh comprising one or more regions that are

15          approximate height fields; and

    d.  splitting each region that does not satisfy a compact shape criterion into one or more subregions that are approximately convex and homeomorphic to discs, resulting in the atlas that is

20          a refined decomposition of the input mesh comprising one or

more charts, each chart being one of the approximate height

fields each chart being approximately convex and

homeomorphic to a disc.


5


10.A computer system, as in claim 9, further comprising the step of:


adjusting one or more boundaries between one or more pairs of charts.


10


11.A computer system, as in claim 9, where the selecting the seed set is a

random process.


15     12.A computer system, as in claim 11, where the selecting the seed set is

done by performing a seed selection process comprising the following

steps:

a. computing colors for the faces of the input mesh from the information provided by the mesh normals;

b. applying an optional smoothing to colors to reduce noise;

5

c. applying a color quantization procedure to identify regions of relatively constant shape over the input mesh;

d. further adjusting the relatively constant shape regions by optionally straightening the boundaries between them; and

10

e. computing an approximate medial axis for each of the relatively constant shape regions and extracting a small set of medial axis samples from regions and letting the seed set be the union of these samples.

15

13. A computer system, as in claim 12, where the color quantization process comprises the following steps:

a. selecting a set of representative colors; and

b. applying a color classification procedure into classes corresponding to the set of representative colors.

5

14. A computer system, as in claim 8, where the quadrilateral mesh extraction process comprises the steps of:

10

a. extracting a boundary set of one or more boundaries curves between one or more charts in the atlas; and

b. for each of the charts, creating a polygonal approximation of the chart, by simplifying one or more boundary curves

15

corresponding to the charts, resulting in a coarse polygonal mesh.

15. A computer system, as in claim 13, further comprising the step of:

20

c.  removing unnecessary faces and edges of the coarse polygonal

mesh.

5       16. A computer system, as in claim 13, further comprising the step of:

c. quadrangulating the coarse polygonal mesh if the coarse polygonal

mesh is not a quadrilateral mesh.

10

17. A method of converting a 2-manifold polygon mesh into a

multiresolution qualdrilateral subdivision surface, the method comprising

the steps of:

15           a.  generating an atlas decomposition of the input mesh by

using an atlas generation process;

b.  extracting a quadrilateral base mesh using a quadrilateral

mesh extraction process, the atlas, and the input mesh;

and

c. extracting the MQSS with one or more levels from the input mesh and the quadrilateral base mesh.

5

18. A system for converting a 2-manifold polygon mesh into a multiresolution qualdrilateral subdivision surface, the system comprising:

10

a. means for generating an atlas decomposition of the input mesh by using an atlas generation process;

b. means for extracting a quadrilateral base mesh using a quadrilateral mesh extraction process, the atlas, and the

15

input mesh; and

c. means for extracting the MQSS with one or more levels from the input mesh and the quadrilateral base mesh.

20

19. A computer program product for converting a 2-manifold polygon

mesh into a multiresolution qualdrilateral subdivision surface, the

computer program having a method comprising the steps of:

5
    a. generating an atlas decomposition of the input

       mesh by using an atlas generation process;

    b. extracting a quadrilateral base mesh using a

       quadrilateral mesh extraction process, the atlas,

10     and the input mesh; and

    c. extracting the MQSS with one or more levels from

       the input mesh and the quadrilateral base mesh.

15